December 2011 MSS/LPS/SPS Joint Subcommittee Meeting

ABSTRACT SUBMITTAL FORM

The submission of an abstract is an agreement to complete a final paper for publication and attend the meeting to present this information. Complete all information requested in the author and co-author information sections; the first author listed will receive paper acceptance notices and all correspondence. Abstracts must be submitted electronically; submittal instructions are located in the call for papers. **The abstract deadline date is June 13, 2011.**

ABSTRACT INFORMATION

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ABSTRACT SUBMITTAL FORM

Unclassified Abstract

(250-300 words; do not include figures or tables)

Engine LH2 and LO2 gas generator feed assemblies were modeled with computational fluid dynamics (CFD) methods at 100% rated power level, using on-center square- and round-edge orifices. The purpose of the orifices is to regulate the flow of fuel and oxidizer to the gas generator, enabling optimal power supply to the turbine and pump assemblies. The unsteady Reynolds-Averaged Navier-Stokes equations were solved on unstructured grids at second-order spatial and temporal accuracy. The LO2 model was validated against published experimental data and semi-empirical relationships for thin-plate orificies over a range of Reynolds numbers. Predictions for the LO2 square- and round-edge orifices precisely match experiment and semi-empirical formulas, despite complex feedline geometry whereby a portion of the flow from the engine main feedlines travels at a right-angle through a smaller-diameter pipe containing the orifice. Predictions for LH2 square- and round-edge orifice designs match experiment and semi-empirical formulas to varying degrees depending on the semi-empirical formula being evaluated. LO2 mass flow rate through the square-edge orifice is predicted to be 25 percent less than the flow rate budgeted in the original engine balance, which was subsequently modified. LH2 mass flow rate through the square-edge orifice is predicted to be 5 percent greater than the flow rate budgeted in the engine balance. Since CFD predictions for LO2 and LH2 square-edge orifice pressure loss coefficients, K, both agree with published data, the equation for K has been used to define a procedure for orifice sizing.